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United States Department of Agriculture
Agricultural Research Service
Southern Utilization Research Branch
2100 Robert E. Lee Boulevard
New Orleans, Louisiana

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THE STELOMETER

AN INSTRUMENT FOR TENSILE AND ELONGATION MEASUREMENTS

The Stelometer is a new instrument for measuring the breaking strength (tenacity) and elongation at break of bundles of cotton fiber. It was developed by the University of Tennessee Fiber Research Laboratory in Knoxville, Tennessee, under a research contract sponsored by the U. S. Department of Agriculture. The name is derived from words, strength and elongation, the physical properties which it measures, together with "meter."

The instrument was designed and the method of preparing bundles for testing was developed after extensive studies of possible sources of variation in the existing methods of measuring strength of flat bundles of fibers. The tester is constructed on a new principle for pendulum testers. Front and rear views of the instrument are shown in Figures 1 and 2, respectively. The center of mass of the pendulum (G) is at the center of rotation (I) of the frame while the pendulum pivot (H) rotates with the frame. This reduces the pulsating motions inherent in so many testers of this type. The bundle of fibers is held in jaws which are inserted in grooves (C) of both the frame and the extended pendulum. Load is applied by the pendulum, which due to unbalanced load on the frame causes the angular rotation of the frame about its pivot. Load is indicated by a pointer which follows the rotation along scale (A) until the bundle breaks. Since the contact between the pendulum and pointer is interrupted immediately upon the break of the bundle, inertia of rotation has relatively little effect on the stress reading. At the same time that the pointer is recording the load, a dial (B) registers the movement of the pendulum with respect to its frame and hence the sample stretch. This displacement is magnified to give an overall magnification of the stretch of about 30 times and is a measure of the amount that the bundle has elongated under that load. The contact of the pendulum with this dial is also interrupted at the moment when the bundle breaks. Rotation of the frame is clockwise in Figure 1 and is controlled by escape of air from cylinder (J) to give constant rate of loading. The rate of loading can be changed easily within a range from 0.05 to 4.0 kg/sec., by merely adjusting the rate that air escapes from this cylinder. Accessories used in preparing, clamping and handling the sample and specimen during the test are shown also in Figure 1.

Torque vise: The torque vise shown in Figure 3 is so constructed that spacers up to 1/2 inch in thickness can be used with the Pressley jaws (K). The vise is tilted at an angle of 45° so that the bundle (L) is under slight tension between the clip (N) on the upper side of the jaws and the weight

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The instrument was designed and the method of measuring bundles for testing was developed after [illegible] study of possible sources of variation in the [illegible] of measuring strength of flat bundles of fibers. The [illegible] is [illegible] new principle [illegible]. Front and rear views of the instrument are shown in Figures 1 and 2, respectively. [illegible] (1) [illegible] rotation (2) of the frame [illegible] (3) [illegible] the fiber [illegible] the length of [illegible] in [illegible] (6) of both the [illegible]. Load is applied by the pendulum, which [illegible] rotation of the frame about the pivot. [illegible] pawl which follows the [illegible] until the bundle breaks. Since the [illegible] between the pendulum and [illegible] upon the break of the bundle, [illegible] at the same time [illegible] (8) [illegible] the [illegible] and [illegible]. This displacement is amplified to give [illegible] of the [illegible] about [illegible] that the [illegible]. The [illegible] at the moment when the bundle breaks. Rotation of the frame is [illegible] in Figure 1 [illegible] of the [illegible] cylinder (4) to give constant rate of loading. The rate of loading can be [illegible] within a range from [illegible] to [illegible] by simply adjusting the [illegible] from this cylinder. Accessories used [illegible], clamps, and [illegible], are shown also in Figure 3.

Fiber clamp. The [illegible] shown in Figure 3 is [illegible] 1/8 inch. [illegible] can be used with the [illegible] (7). [illegible] is tilted at an angle of 45° so that the [illegible] (1) is [illegible] between the [illegible] (9) on the upper side of the jaws and the [illegible]

of the transfer clip (M) on the lower side. The jaw vise with the indicating dial (O) is so constructed as to enable the operator to read the amount of torque applied to the screws when fastening the Pressley jaws. Experiments have shown that a torque of 8 lb. ins. gives an optimum clamping pressure for reproducible results. This force is sufficient to prevent slippage but does not cause excessive damage to the leather surfaces used to face the jaws. The use of the jaws for an extended period of time without the necessity of changing the leather pads shows that this technique reduces the deterioration of leather, which was one source of variation in previous testing. While the vise was developed especially for the Stelometer, it can be used also with the Pressley tester.

Testing Technique: In order to reduce several known sources of non-reproducibility, the testing technique for the new tester was altered from that used with the Pressley instrument. The hands are not allowed to touch the sample at any stage in the process of preparing the test specimen or while making the test. This provision eliminates the disturbing effects of variable moisture being transmitted to the fibers by the operator. Randomizing the fibers on a Fibrograph comb (as for length measurements) enables the operator to prepare bundles of representative fibers of uniform thickness. These are transferred from the comb with a fiber clamp of 5/16 inch width, thus giving a specimen which is uniform in both width and thickness. The slight tension placed on the fibers when the jaw is closed is reproducible, since it is the uniform weight of the fiber transfer clamp.

Strength: Bundle strength is calculated from the breaking load, in kilograms, and bundle weight in milligrams, and expressed as kg./mg. These units can be easily converted to tenacity in grams/grex, through consideration of the bundle length, in cm. Efforts were made to eliminate several minor instrument errors and to make the test conditions for strength of fibers comparable with those for yarns and cords. Loading can be controlled at rates comparable with those used for yarns. Gage length of specimen tested can be varied within the range of 0 to 12 mm.; this makes it possible to compare strengths of fibers determined at gage lengths other than zero, with the strength of yarns produced from these fibers. The most significant gage lengths appear to be 0 and about 3 mm., or 1/8 in. Overcoast, which occurs with many testers, is essentially absent in the Stelometer at normal rates of loading, and for rapid rates of loading a scale is provided for correcting the readings. To increase the confidence of the operator in results of the test, provisions are made for easily checking both the level of the instrument and other operating conditions which influence strength readings.

Elongation: Elongation of the bundles at break, magnified on the average 30 times, can be determined from the Stelometer readings. Little is known of the relationship of elongation at break of fiber bundles to the usefulness of cottons or its value for prediction of other important textile properties. However, even aside from this the elongation reading indicates those occasional bundles which have slipped before breaking, and the inclusion of whose values would introduce errors into the results. In tests with the Stelometer using greater-than-zero jar spacing, several cottons with different known fiber characteristics were studied and found to give reproducible

differences in the elongation readings. Since elongation of synthetic fibers is a known index of their performance, it seems logical that elongation of cotton fibers would also be an important index of performance characteristics. Its usefulness in the prediction of important textile properties of yarns and fabrics can now be explored. While the time required to make an observation with the Stelometer is essentially the same as that with the Pressley instrument, in the new technique a combination of length and strength on the same sample can be made in less time than when made separately as required in existing techniques. Also improvements in sampling and testing techniques, such as homogenizing the sample, uniformly tensioning the fibers before clamping, controlling clamping pressure, mechanizing sample preparation and transfer, and applying a uniform rate of loading have increased the reproducibility and thereby reduced the number of observations required to obtain the same accuracy of testing as secured in the standard method, used with the Pressley instrument.

A public service patent application has been filed by the U. S. Department of Agriculture. Dr. K. L. Hertel of the University of Tennessee, who was largely responsible for the instrumentation, is preparing a technical article describing the Stelometer more fully. It is understood that a limited number of Stelometers will be made commercially available. In the meantime the instrument is being used at the Southern Regional Research Laboratory for measurements in comparisons with those from the Pressley flat bundle tester and also for comparative studies with a single fiber tester. These data are being assembled for publication from the Southern Regional Research Laboratory.

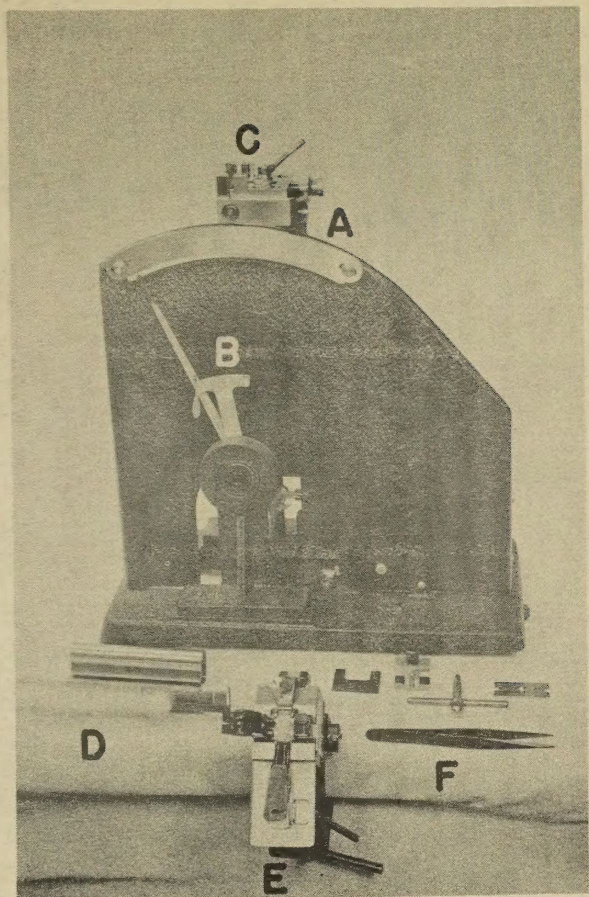

FIGURE I - FRONT VIEW OF STELOMETER

A, load scale; B, elongation scale; C, jaw grooves. Accessories–D, comb with test sample; E, torque vise, Pressley jaws, and specimen clamp; F, jaw spacer, wrench, shearing blade and forceps.

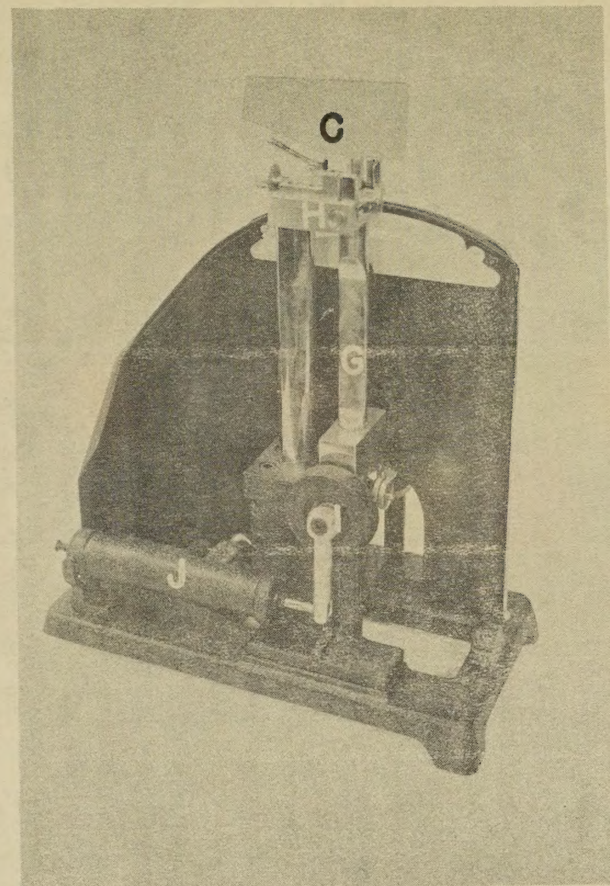

FIGURE 2 – REAR VIEW OF STELOMETER

C, adjustable grooves for holding Pressley jaws; G, load pendulum; H, pendulum pivot; I, frame pivot; J, air piston for control of rate of loading.

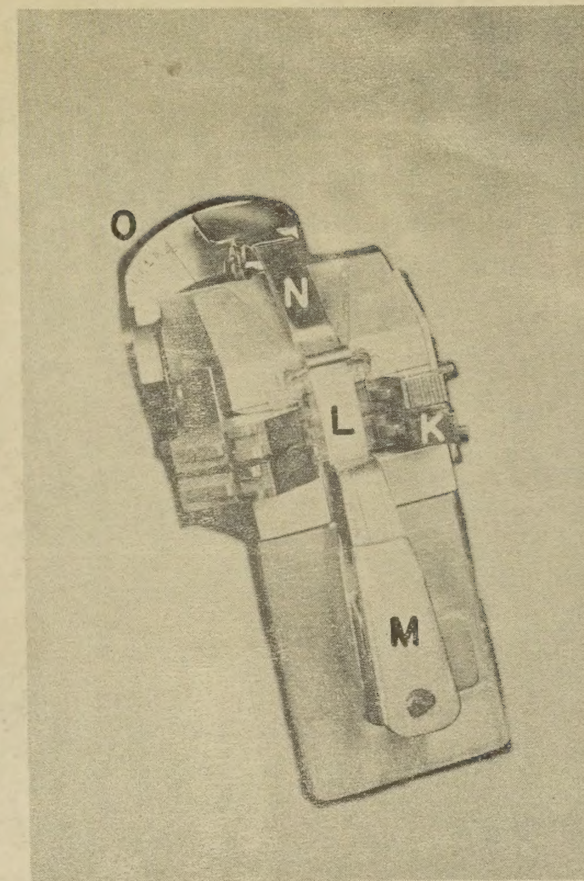

FIGURE 3 – TOP VIEW OF TORQUE VISE

K, Pressley jaws; L, test specimen; M, specimen clamp; N, fiber tensioning clip; O, torque scale.